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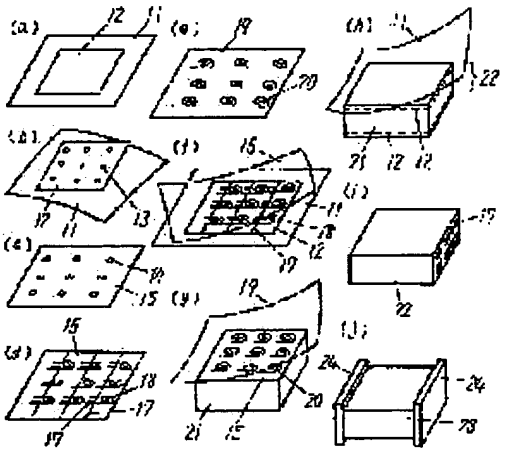
(54) MANUFACTURING LAMINATED CHIP INDUCTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To manufacture a laminated chip inductor with almost no crack at bonded faces.

SOLUTION: A first magnetic green sheet 12 and second magnetic green sheet filled with a conductive material 14 are formed, first conductors 18 having electroplated leading electrodes 17 and second conductors 20 are formed, the first and second conductors 18 and 20 are transferred to the first and 2nd magnetic green sheets 12 and 15, which are laminated to form an intermediate laminate 21 and it is cut into pieces 23 to form end face electrodes 24.



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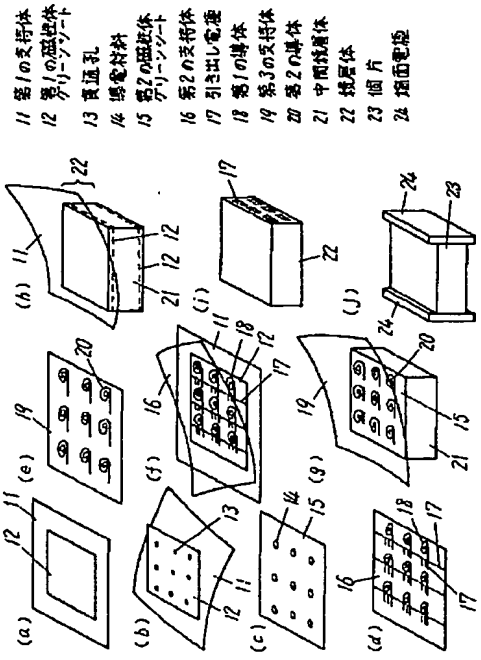
(54)【発明の名称】　積層チップインダクタの製造方法

(57)【要約】
【課題】　接合面にクラックが発生しにくい積層チップインダクタの製造方法を提供することを目的とする。
【解決手段】　第１の磁性体グリーンシート１２を形成し、導電材料１４が充填された第２の磁性体グリーンシート１５を形成し、電気めっきより引き出し電極１７を有する第１の導体１８および第２の導体２０を形成し、第１の磁性体グリーンシート１２に第１の導体１８を転写し、第２の磁性体グリーンシート１５に第２の導体２０を転写・積層して形成された中間積層体２１の上・下面に転写し、個片２３に切断し焼成して端面電極２４を形成するものである。



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【特許請求の範囲】

【請求項１】　第１の支持体の上面に磁性体スラリーをシート状に塗布・乾燥して第１の磁性体グリーンシートを形成する第１のシート形成工程と、

前記第１の支持体を剥離した後前記第１の磁性体グリーンシートに複数個の貫通孔を形成しこの貫通孔に導電材料を充填して第２の磁性体グリーンシートを形成する第２のシート形成工程と、

第２の支持体の上面に電気めっきにより複数本の引き出し電極を有するコイル状の第１の導体を複数個形成する第１のめっき工程と、

第３の支持体の上面に電気めっきによりコイル状の第２の導体を複数個形成する第２のめっき工程と、

前記第１のシート形成工程で得られた第１の磁性体グリーンシートの上面に前記第１の導体を熱圧着により転写して第２の支持体を剥離する転写工程と、

前記第２のシート形成工程で得られた第２の磁性体グリーンシートの上面に前記第２の導体を前記第２の磁性体グリーンシートに充填された導電材料を介して電気的に接続するように熱圧着により転写し第３の支持体を剥離・積層を繰り返して中間積層体を形成する中間積層体形成工程と、

前記中間積層体の上面と下面とに前記第１の導体を転写した第１の磁性体グリーンシートを導電材料を介して電気的に接続するように熱圧着により転写し前記第１の支持体を剥離して積層体を形成する積層体形成工程と、

前記積層体形成工程で得られた積層体を前記引き出し電極を切断するように個片に切断し焼成する個片形成工程と、

前記個片形成工程で焼成された前記個片の対向する端面に前記引き出し電極と電気的に接続するように端面電極を形成する電極形成工程とからなる積層チップインダクタの製造方法。

【請求項２】　引き出し電極は、隣接する少なくとも２方向で切断されるように形成する請求項１記載の積層チップインダクタの製造方法。

【請求項３】　引き出し電極は、端面電極との接続部で幅が異なるように形成する請求項１記載の積層チップインダクタの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、小型デジタル電子機器の高密度実装回路基板に用いられ、電子回路の直流電源ラインに発生するノイズを抑制する積層チップインダクタの製造方法に関するものである。

【０００２】

【従来の技術】近年、積層チップインダクタは、デジタル機器の小型・薄形化に伴う高密度実装回路基板からのノイズを抑制するノイズ対策部品として用途が拡大されている。

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【０００３】以下、従来の積層チップインダクタについて説明する。従来の積層チップインダクタは、実願昭５９－１６２０３１号（実開昭６１－７６９２８号）のマイクロフィルムに、コ字状の導体パターンを上面に有するセラミックシートが複数枚積層されてなる磁性体層と、各磁性体層の導体パターンを電気的に接続するスルーホールと、このスルーホールの周縁に設けられた補強用導体パターンと、この磁性体層の上・下面のそれぞれに設けられた磁性体層とで一体積層物をなし、この一体積層物の対向する両端面に端面電極を設けたものが開示されている。

【０００４】以下、従来の積層チップインダクタについて、図面を参照しながら説明する。図４は従来の積層チップインダクタの一部を分解した分解斜視図、図５は同斜視図である。

【０００５】図において、１は磁性材料からなる磁性体グリーンシートである。２は磁性体グリーンシート１の上面に銀パラジウム等の導電材料をコ字状に印刷して形成された導体パターンで、コ字状の一端に幅を広くした引き出し電極３が設けられている。４は磁性体グリーンシート１の上面に銀パラジウム等の導電材料をコ字状に印刷して形成された金属よりなる導体パターンである。

【０００６】このような従来のチップインダクタは、まず上面に導体パターン４が設けられた磁性体グリーンシート１を複数枚積層し、その上・下面に導体パターン２が設けられた磁性体グリーンシート１を積層して中間積層体５を形成し、次に中間積層体５の上・下面に磁性体グリーンシート１を積層したものを熱圧着・焼成して一体形成し、対向する端面に導体パターンと電気的に接続するように銀等の金属ペーストで端面電極６を塗布して製造していた。

【０００７】

【発明が解決しようとする課題】しかしながら、上記従来のものでは、磁性体グリーンシート１の間に導体パターン４を挟み込んで積層・焼成する際、導体パターンの金属と磁性体グリーンシートとの収縮率が異なるため、接合面からクラックが発生するという課題を有するものである。

【０００８】上記課題を解決するために本発明は、磁性体グリーンシートと金属の導体とを積層しても接合面にクラックが発生しにくい積層チップインダクタの製造方法を提供することを目的とするものである。

【０００９】

【課題を解決するための手段】上記目的を達成するために本発明は、第２の支持体の上面に電気めっきにより複数本の引き出し電極を有するコイル状の第１の導体を複数個形成する工程とを有するものである。

【００１０】

【発明の実施の形態】本発明の請求項１に記載の発明は、第１の支持体の上面に磁性体スラリーをシート状に

塗布・乾燥して第１の磁性体グリーンシートを形成する第１のシート形成工程と、前記第１の支持体を剥離した後前記第１の磁性体グリーンシートに複数個の貫通孔を形成しこの貫通孔に導電材料を充填して第２の磁性体グリーンシートを形成する第２のシート形成工程と、第２の支持体の上面に電気めっきにより複数本の引き出し電極を有するコイル状の第１の導体を複数個形成する第１のめっき工程と、第３の支持体の上面に電気めっきによりコイル状の第２の導体を複数個形成する第２のめっき工程と、前記第１のシート形成工程で得られた第１の磁性体グリーンシートの上面に前記第１の導体を熱圧着により転写して第２の支持体を剥離する転写工程と、前記第２のシート形成工程で得られた第２の磁性体グリーンシートの上面に前記第２の導体を前記第２の磁性体グリーンシートに充填された導電材料を介して電気的に接続するように熱圧着により転写し第３の支持体を剥離・積層を繰り返して中間積層体を形成する中間積層体形成工程と、前記中間積層体の上面と下面とに前記第１の導体を転写した第１の磁性体グリーンシートを導電材料を介して電気的に接続するように熱圧着により転写し前記第１の支持体を剥離して積層体を形成する積層体形成工程と、前記積層体形成工程で得られた積層体を前記引き出し電極を切断するように個片に切断し焼成する個片形成工程と、前記個片形成工程で焼成された前記個片の対向する端面に前記引き出し電極と電気的に接続するように端面電極を形成する電極形成工程とを有するものである。

【００１１】また、請求項２に記載の発明は、請求項１の発明の引き出し電極は、隣接する少なくとも２方向で切断されるように形成するものである。

【００１２】また、請求項３に記載の発明は、請求項１の発明の引き出し電極は、端面電極との接続部で幅が異なるように形成するものである。

【００１３】上述した請求項により、積層時に磁性体グリーンシートと導体との接合面にクラックが発生しにくく、かつ端面電極と導体との接続が向上するという作用を有するものである。

【００１４】以下、本発明の一実施の形態における積層チップインダクタの製造方法について、図面を参照しながら説明する。

【００１５】図１は本発明の一実施の形態における積層チップインダクタの製造方法を示す工程図である。

【００１６】まず、図１（ａ）に示すように、ブチラール等の樹脂と酢酸ブチル等の溶剤と可塑剤とを溶解させたビヒクルと、Ｎｉ・Ｚｎ・Ｃｕ系のフェライト粉末とを混練してなる磁性体スラリーを第１の支持体１１の上面にドクターブレード法でシート状に塗布し、約７０℃で乾燥して第１の磁性体グリーンシート１２を形成する。

【００１７】次に、図１（ｂ）に示すように、第１の支持体１１を剥離した第１の磁性体グリーンシート１２にパンチング等により直径０．１～０．２ｍｍ程度の貫通孔１３を形成する。

【００１８】次に、図１（ｃ）に示すように、貫通孔１３に銀または銀パラジウム等の導電材料１４を充填して第２の磁性体グリーンシート１５を形成する。

【００１９】次に、図１（ｄ）に示すように、第２の支持体１６の上面にフォトレジストを塗布し、引き出し電極１７を有するコイル状の第１の導体１８を形成するパターンに露光・現像してレジストを剥離し、第２の支持体１６の上面に引き出し電極１７のパターンとコイル状のパターンとを露出させる。この露出させたパターンの上面に電気めっきを３Ａ／ｄｍ²で約２０分間行い、導電性の高い銀等の金属を着膜して引き出し電極１７を有する第１の導体１８を形成する。ここでコイル状の第１の導体１８の幅は約４５μｍで約２ターン、膜厚は約２０μｍであり、引き出し電極１７の幅は約５５μｍで先端が三方向に引き延ばされる構造とした。また、この電気めっきではめっき浴としてノーシアン銀めっき浴（大和化成株式会社製、ＡＧ－ＰＬ３０酸性浴）を用いた。

【００２０】次に、図１（ｅ）に示すように、第３の支持体１９の上面にフォトレジストを塗布し、第２の導体２０を形成するコイル状のパターンに露光・現像してレジストを剥離し、第３の支持体１９の上面にコイル状のパターンを露出させる。この露出させた第３の支持体１９のコイル状のパターンの上面に前工程と同様に電気めっきを行い第２の導体２０を形成する。

【００２１】次に、図１（ｆ）に示すように、第１の磁性体グリーンシート１２の上面に第１の導体１８を約６０～１２０℃で熱圧着して転写し、第２の支持体１６を剥離する。

【００２２】次に、図１（ｇ）に示すように、第２の磁性体グリーンシート１５の上面に第２の導体２０を第２の磁性体グリーンシート１５に充填された導電材料１４を介して電気的に接続するように位置合わせをし、約６０～１２０℃で熱圧着して転写し、第３の支持体１９を剥離する。この転写を繰り返し積層して中間積層体２１を形成する。

【００２３】次に、図１（ｈ）に示すように、中間積層体２１の上面と下面とに第１の導体１８を転写した第１の磁性体グリーンシート１２を導電材料１４を介して電気的に接続するように位置合わせをし、約６０～１２０℃で熱圧着して転写し、第１の支持体１１を剥離して積層体２２を形成する。

【００２４】次に、図１（ｉ）に示すように、積層体２２の内部に形成されている引き出し電極１７が隣接する第１の導体１８との間で二分されるようにダミー部分を残して縦横の切断位置を定め、積層体２２を所定サイズの個片２３に切断する。この切断位置を図２に示す。引き出し電極１７を、隣接する第１の導体１８と一方向の

みで二分されるようにダミー部分２５を残して切断するものである。この後、約９００℃で約１時間焼成する。

【００２５】次に、図１（ｊ）に示すように、前工程で焼成した個片２３の対向する端面に引き出し電極１７と電気的に接続するように銀等の金属ペーストを塗布し、約８５０℃で焼成して端面電極２４を形成する。

【００２６】最後に、必要に応じて端面電極２４を覆うようにニッケルめっき、はんだめっき等を施して積層チップインダクタを製造するものである。

【００２７】このように、積層体２２を個片２３に切断する際、ダミー部分２５を有するため、切断位置や中間積層体２１の積層時の位置ずれが生じても、引き出し電極１７と端面電極２４とが十分に接続されるものである。

【００２８】また、図３に示すように、引き出し電極２６が、隣接する第１の導体２７と少なくとも二方向へ引き延ばされ、ダミー部分２８が二方向以上に形成されると、引き出し電極２６が端面電極２４と接する接続部が二面以上となり、より強固に接続されるものである。

【００２９】また、引き出し電極１７と端面電極２４とが接する接続部が一面であれば、引き出し電極１７の幅を広く取らなければ電気的に十分な接続が得られない＊

＊が、引き出し電極１７が二面以上で接続されているため、幅を広く取る必要がなく端面電極２４との接続部で引き出し電極１７の幅を狭くする等、幅が異なるように形成してもよい。

【００３０】ここで、本発明の一実施の形態における積層チップインダクタを、引き出し電極の本数と幅とを変えて試作し、電気的接続率と端面クラックの発生率を比較する。

【００３１】本発明の一実施の形態における積層チップインダクタを、膜厚を一定にし、引き出し電極の本数が一方向から四方向に引き延ばされる構造で、引き出し電極幅を２０～１００μｍにしたものを各２００個ずつ試作した。このとき、コイル状の第１の導体より０．５Ωの抵抗値が得られるように設計し、本発明の一実施の形態における積層チップインダクタの抵抗値が０．７Ω以下のものは断線せず、電気的接続がされているものである。この試作品全数に対し電気的接続されている割合（電気的接続率）と端面クラックの発生率を比較したものを（表１）に示す。

【００３２】

【表１】

サンプル番号	引き出し電極幅（μｍ）	引き出し本数（本）	膜厚（μｍ）	導体断面積（μｍ²）	電気的接続率（％）	端面クラックの発生率（％）
1	１００	3	２０	６０００	１００	0
2	１００	1	２０	２０００	９９	0
3	５０	3	２０	３０００	１００	0
4	２０	4	２０	１６００	１００	0
5	２０	3	２０	１２００	１００	0
6	２０	2	２０	８００	９３	0
7	２０	1	２０	４００	８９	0

【００３３】（表１）より、引き出し電極幅が２０μｍと狭い場合は、引き出し本数を増やすほど導体断面積が増し、電気的接続率が高まることがわかる。引き出し本数が３本の場合、電気的接続率は導体断面積が約１２００μｍ²になると十分な接続が得られる。また、引き出し電極幅が１００μｍと広い場合は、引き出し本数が１本でも十分な電気的接続率が得られるものである。

【００３４】なお、上述した製造方法では、第２の磁性体グリーンシート１５と第２の導体２０とをあらかじめ複数回積層し、中間積層体２１としてさらに第１の導体１８を転写した第１の磁性体グリーンシート１２を転写・積層したが、中間積層体２１を形成せずに第１の磁性体グリーンシート１２の上面に順次転写・圧着してもよい。

【００３５】

【発明の効果】以上のように本発明は、磁性体グリーンシートと金属の導体とを積層しても接合面にクラックが発生しにくく、かつ端面電極と導体との電気的な接続が向上する積層チップインダクタの製造方法を提供することができるものである。

【図面の簡単な説明】

【図１】本発明の一実施の形態における積層チップインダクタの製造方法を示す工程図

【図２】同要部である引き出し電極と積層体との切断位置を示す図

【図３】同要部である他の引き出し電極と積層体との切断位置を示す図

【図４】従来のチップ形インダクタの構造を示す分解斜視図

【図５】同斜視図

【符号の説明】

１１　第１の支持体

１２　第１の磁性体グリーンシート

１３　貫通孔

7

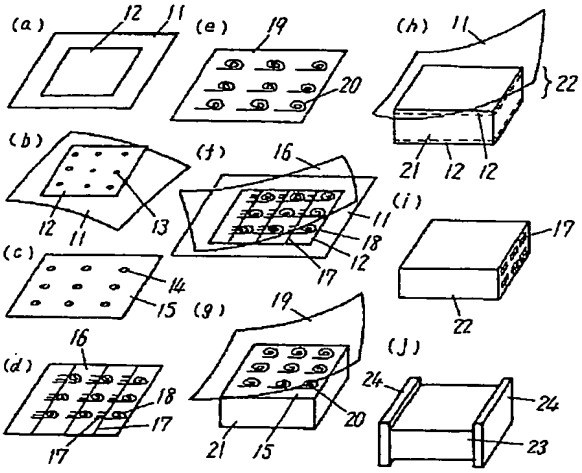
１４　導電材料
１５　第２の磁性体グリーンシート
１６　第２の支持体
１７　引き出し電極
１８　第１の導体
１９　第３の支持体

8

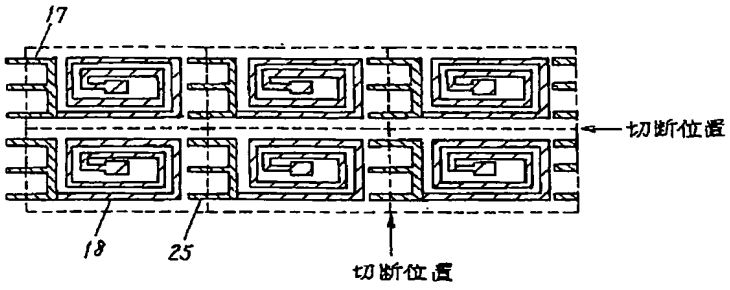
＊２０　第２の導体
２１　中間積層体
２２　積層体
２３　個片
２４　端面電極

＊

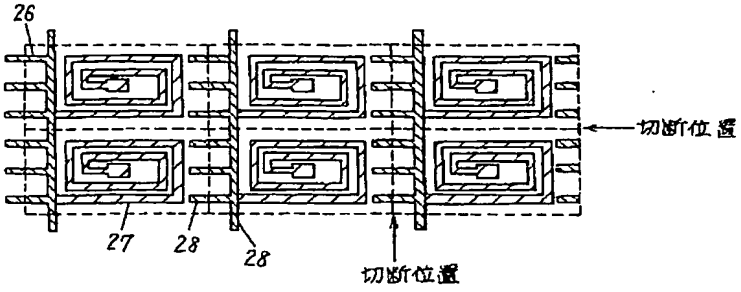
【図１】



【図２】



【図３】



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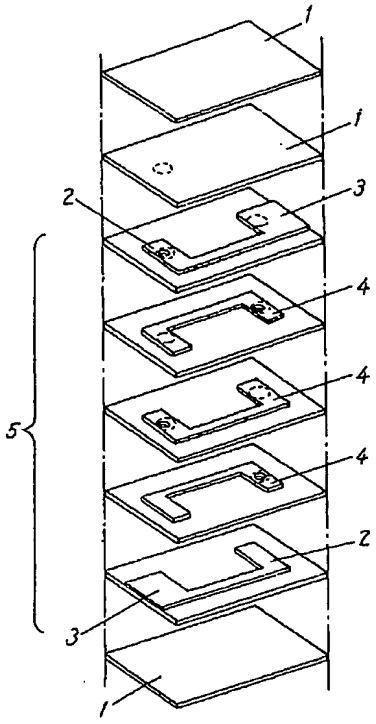
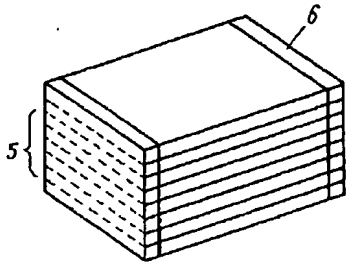


【図５】



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CLAIMS

[Claim(s)]
[Claim 1] The 1st sheet formation process which applies and dries a magnetic-substance slurry in the shape of a sheet, and forms the 1st magnetic-substance green sheet in the top face of the 1st base material, The 2nd sheet formation process which forms two or more through tubes in the magnetic-substance green sheet of the account 1st of back to front which exfoliated said 1st base material, fills up this through tube with an electrical conducting material, and forms the 2nd magnetic-substance green sheet, The 1st plating process which forms in the top face of the 2nd base material two or more 1st coiled form conductor which has two or more drawer electrodes by electroplating, The 2nd plating process which forms two or more 2nd coiled form conductor in the top face of the 3rd base material by electroplating, The imprint process which imprints said 1st conductor by thermocompression bonding on the top face of the 1st magnetic-substance green sheet obtained with said 1st sheet formation process, and exfoliates the 2nd base material, So that it may connect with the top face of the 2nd magnetic-substance green sheet obtained with said 2nd sheet formation process electrically through the electrical conducting material filled up with said 2nd conductor by said 2nd magnetic-substance green sheet The middle layered product formation process which imprints by thermocompression bonding, repeats exfoliation and a laminating for the 3rd base material, and forms a middle layered product, The layered product formation process which imprints by thermocompression bonding, exfoliates said 1st base material, and forms a layered product so that the 1st magnetic-substance green sheet which imprinted said 1st conductor may be electrically connected to the top face and inferior surface of tongue of said middle layered product through an electrical conducting material, The piece formation process of an individual which cuts and calcinates the layered product obtained with said layered product formation process to the piece of an

individual so that said drawer electrode may be disconnected, The manufacture approach of a laminating chip inductor which consists of an electrode formation process which forms an end-face electrode so that it may connect with said drawer electrode electrically at the end face which said piece of an individual calcinated with said piece formation process of an individual counters.
[Claim 2] A drawer electrode is the manufacture approach of the adjoining laminating chip inductor according to claim 1 formed so that it may be cut by the 2-way at least.
[Claim 3] A drawer electrode is the manufacture approach of the laminating chip inductor according to claim 1 formed so that width of face may differ by the connection with an end-face electrode.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is used for the high-density-assembly circuit board of small digital electronic equipment, and relates to the manufacture approach of the laminating chip inductor which controls the noise generated in DC-power-supply Rhine of an electronic circuitry.
[0002]
[Description of the Prior Art] In recent years, the application is expanded as noise cure components with which a laminating chip inductor controls the noise from the high-density-assembly circuit board accompanying small and the formation of a thin form of a digital instrument.
[0003] Hereafter, the conventional laminating chip inductor is explained.

The magnetic layer to which it comes to carry out two or more sheet laminating of the ceramic sheet with which the conventional laminating chip inductor has a KO character-like conductor pattern on the top face on the microfilm of an application for utility model registration No. (JP,61-76928,U) 162031 [Showa 59 to], The through hole which connects the conductor pattern of each magnetic layer electrically, and the conductor pattern for reinforcement prepared in the periphery of this through hole, what really prepared the end-face electrode in the both-ends side where laminated material nothing and really [this] counters laminated material by the magnetic layer which this magnetic layer top and the inferior surface of tongue were alike, respectively, and was prepared is indicated.

[0004] Hereafter, the conventional laminating chip inductor is explained, referring to a drawing. The decomposition perspective view and drawing 5 into which drawing 4 decomposed a part of conventional laminating chip inductor are this perspective view.

[0005] In drawing, 1 is a magnetic-substance green sheet which consists of a magnetic material. 2 is the conductor pattern which printed electrical conducting materials, such as silver palladium, on the top face of the magnetic-substance green sheet 1 in the shape of a KO character, and was formed in it, and the drawer electrode 3 which made width of face large is formed in the KO character-like end. 4 is a conductor pattern which consists of a metal which printed electrical conducting materials, such as silver palladium, on the top face of the magnetic-substance green sheet 1 in the shape of a KO character, and was formed in it.

[0006] Such a conventional chip inductor carries out two or more sheet laminating of the magnetic-substance green sheet 1 with which the conductor pattern 4 was first formed in the top face. Carry out the laminating of the magnetic-substance green sheet 1 with which the conductor pattern 2 was moreover formed in - inferior surface of tongue, and the middle layered product 5 is formed. Next, the end-face electrode 6 was applied and manufactured with metal pastes, such as silver, so that it might calcinate, it might really form and what carried out the laminating of the magnetic-substance green sheet 1 to the middle layered product 5 top and the inferior surface of tongue might be electrically connected with a conductor pattern at thermocompression bonding and the end face which counters.

[0007]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional thing, since a conductor pattern 4 is put between

the magnetic-substance green sheets 1, and contraction of the metal of a conductor pattern and a magnetic-substance green sheet differs in case it calcinates, a laminating and, it has the technical problem that a crack occurs from a plane of composition.

[0008] In order to solve the above-mentioned technical problem, even if this invention carries out the laminating of a magnetic-substance green sheet and the metaled conductor, it aims at offering the manufacture approach of the laminating chip inductor which a crack cannot generate easily in a plane of composition.

[0009]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention has the process which forms in the top face of the 2nd base material two or more 1st coiled form conductor which has two or more drawer electrodes by electroplating.

[0010]

[Embodiment of the Invention] The 1st sheet formation process with which invention of this invention according to claim 1 applies and dries a magnetic-substance slurry in the shape of a sheet, and forms the 1st magnetic-substance green sheet in the top face of the 1st base material, The 2nd sheet formation process which forms two or more through tubes in the magnetic-substance green sheet of the account 1st of back to front which exfoliated said 1st base material, fills up this through tube with an electrical conducting material, and forms the 2nd magnetic-substance green sheet, The 1st plating process which forms in the top face of the 2nd base material two or more 1st coiled form conductor which has two or more drawer electrodes by electroplating, The 2nd plating process which forms two or more 2nd coiled form conductor in the top face of the 3rd base material by electroplating, The imprint process which imprints said 1st conductor by thermocompression bonding on the top face of the 1st magnetic-substance green sheet obtained with said 1st sheet formation process, and exfoliates the 2nd base material, So that it may connect with the top face of the 2nd magnetic-substance green sheet obtained with said 2nd sheet formation process electrically through the electrical conducting material filled up with said 2nd conductor by said 2nd magnetic-substance green sheet The middle layered product formation process which imprints by thermocompression bonding, repeats exfoliation and a laminating for the 3rd base material, and forms a middle layered product, The layered product formation process which imprints by thermocompression bonding, exfoliates said 1st base material, and forms a layered product so that the 1st magnetic-substance green sheet which imprinted said 1st conductor may be electrically connected to the top

face and inferior surface of tongue of said middle layered product through an electrical conducting material, The piece formation process of an individual which cuts and calcinates the layered product obtained with said layered product formation process to the piece of an individual so that said drawer electrode may be disconnected, It has the electrode formation process which forms an end-face electrode so that it may connect with said drawer electrode electrically at the end face which said piece of an individual calcinated with said piece formation process of an individual counters.

[0011] Moreover, invention according to claim 2 is a thing which the drawer electrode of invention of claim 1 adjoins and which is formed so that it may be cut by the 2-way at least.

[0012] Moreover, the drawer electrode of invention of claim 1 forms invention according to claim 3 so that width of face may differ by the connection with an end-face electrode.

[0013] It has an operation that are hard to generate a crack in the plane of composition of a magnetic-substance green sheet and a conductor at the time of a laminating, and connection between an end-face electrode and a conductor improves by the claim mentioned above.

[0014] Hereafter, the manufacture approach of the laminating chip inductor in the gestalt of 1 operation of this invention is explained, referring to a drawing.

[0015] Drawing 1 is process drawing showing the manufacture approach of the laminating chip inductor in the gestalt of 1 operation of this invention.

[0016] First, as shown in drawing 1 (a), the magnetic-substance slurry which comes to knead the vehicle in which resin, solvents, such as butyl acetate, and plasticizers, such as butyral, were dissolved, and the ferrite powder of a nickel-Zn-Cu system is applied to the top face of the 1st base material 11 in the shape of a sheet with a doctor blade method, it dries at about 70 degrees C, and the 1st magnetic-substance green sheet 12 is formed.

[0017] Next, as shown in drawing 1 (b), the through tube 13 with a diameter of about 0.1-0.2mm is formed in the 1st magnetic-substance green sheet 12 which exfoliated the 1st base material 11 by punching etc.

[0018] Next, as shown in drawing 1 (c), a through tube 13 is filled up with the electrical conducting materials 14, such as silver or silver palladium, and the 2nd magnetic-substance green sheet 15 is formed.

[0019] Next, as shown in drawing 1 (d), a photoresist is applied to the top face of the 2nd base material 16, negatives are exposed and developed, and it exfoliates, a resist is pulled out on the top face of

the 2nd base material 16, and the pattern of an electrode 17 and a coiled form pattern are exposed to the pattern which forms the 1st coiled form conductor 18 which has the drawer electrode 17. Electroplating is performed on the top face of this exposed pattern for about 20 minutes by 3 A/dm2, and the 1st conductor 18 which carries out film deposition of the metals, such as conductive high silver, pulls them out, and has an electrode 17 is formed. In about 45 micrometers, the width of face of the 1st conductor 18 of a coiled form [here] is about 2 turns, thickness is about 20 micrometers, and width of face of the drawer electrode 17 was made into the structure where a tip is extended by the three way by about 55 micrometers. Moreover, in this electroplating, the no silver cyanide plating bath (Yamato formation incorporated company make, an AG-PL30 acidity bath) was used as a plating bath.

[0020] Next, a photoresist is applied to the top face of the 3rd base material 19, negatives are exposed and developed, a resist is exfoliated to the coiled form pattern which forms the 2nd conductor 20, and the top face of the 3rd base material 19 is made to expose a coiled form pattern to it, as shown in drawing 1 (e). Electroplating is performed on the top face of the coiled form pattern of this 3rd exposed base material 19 like a last process, and the 2nd conductor 20 is formed in it.

[0021] Next, as shown in drawing 1 (f), at about 60-120 degrees C, thermocompression bonding of the 1st conductor 18 is carried out to the top face of the 1st magnetic-substance green sheet 12, it is imprinted on it, and the 2nd base material 16 is exfoliated.

[0022] Next, as shown in drawing 1 (g), alignment is carried out so that it may connect with the top face of the 2nd magnetic-substance green sheet 15 electrically through the electrical conducting material 14 filled up with the 2nd conductor 20 by the 2nd magnetic-substance green sheet 15, and at about 60-120 degrees C, thermocompression bonding is carried out, it imprints, and the 3rd base material 19 is exfoliated. The laminating of this imprint is repeated and carried out, and the middle layered product 21 is formed.

[0023] Next, as shown in drawing 1 (h), alignment is carried out so that the 1st magnetic-substance green sheet 12 which imprinted the 1st conductor 18 may be electrically connected to the top face and inferior surface of tongue of the middle layered product 21 through an electrical conducting material 14, and at about 60-120 degrees C, thermocompression bonding is carried out, it imprints, the 1st base material 11 is exfoliated, and a layered product 22 is formed.

[0024] Next, as shown in drawing 1 (i), it leaves a dummy part, a

cutting location in every direction is defined so that it may be divided into two between the 1st conductor 18 with which the drawer electrode 17 currently formed in the interior of a layered product 22 adjoins, and a layered product 22 is cut to the piece 23 of an individual of predetermined size. This cutting location is shown in drawing 2 . It leaves the dummy part 25 and the drawer electrode 17 is disconnected so that it may be divided into two only in the 1st adjoining conductor 18 and adjoining one direction. Then, it calcinates at about 900 degrees C for about 1 hour.

[0025] Next, as shown in drawing 1 (j), metal pastes, such as silver, are applied so that it may pull out to the end face which the piece 23 of an individual calcinated at the last process counters and may connect with an electrode 17 electrically, and it calcinates at about 850 degrees C, and the end-face electrode 24 is formed.

[0026] Finally, nickel plating, solder plating, etc. are performed and a laminating chip inductor is manufactured so that the end-face electrode 24 may be covered if needed.

[0027] Thus, even if the location gap at the time of a cutting location or the laminating of the middle layered product 21 arises since it has the dummy part 25 in case a layered product 22 is cut to the piece 23 of an individual, the drawer electrode 17 and the end-face electrode 24 are fully connected.

[0028] Moreover, if the drawer electrode 26 is extended in the 1st adjoining conductor 27 and at least 2 adjoining directions and the dummy part 28 is formed in the two or more directions as shown in drawing 3 , the connection to which the drawer electrode 26 touches the end-face electrode 24 will become the second [or more] page, and will be connected more firmly.

[0029] Moreover, if the connection which the drawer electrode 17 and the end-face electrode 24 touch is the whole surface, and large width of face of the drawer electrode 17 is not taken, sufficient connection will not be obtained electrically, but since the drawer electrode 17 is connected by the second [or more] page, you may form it not being necessary to take large width of face, pulling out by the connection with the end-face electrode 24, and narrowing width of face of an electrode 17 etc. so that width of face may differ.

[0030] The number and width of face of a drawer electrode are changed, the laminating chip inductor in the gestalt of 1 operation of this invention is made as an experiment here, and the rate of electrical installation is compared with the incidence rate of an end-face crack.

[0031] Every 200 things each which set drawer electrode width of face to

20-100 micrometers were made as an experiment with the structure where fix thickness and the number of a drawer electrode is extended in the four directions from an one direction in the laminating chip inductor in the gestalt of 1 operation of this invention. At this time, it designs so that the resistance of 0.5 ohms may be acquired from the 1st coiled form conductor, and the resistance of the laminating chip inductor in the gestalt of 1 operation of this invention does not disconnect a thing 0.7ohms or less, but electrical installation is carried out. What compared the incidence rate of the rate (rate of electrical installation) by which electrical installation is carried out to this prototype total, and an end-face crack is shown in (Table 1).

[0032]

[Table 1]

サンプル番号	引き出し電極幅 (μm)	引き出し本数 (本)	膜厚 (μm)	導体断面積 (μm²)	電気的接続率 (%)	端面クラックの発生率 (%)
1	100	3	20	6000	100	0
2	100	1	20	2000	99	0
3	50	3	20	3000	100	0
4	20	4	20	1600	100	0
5	20	3	20	1200	100	0
6	20	2	20	800	93	0
7	20	1	20	400	89	0

[0033] when drawer electrode width of face is as narrow as 20 micrometers, so that a drawer number is increased from (Table 1) -- a conductor -- it turns out that the increase of the cross section and the rate of electrical installation increase. the case where a drawer number is three -- the rate of electrical installation -- a conductor -- sufficient connection will be obtained if about 1200 micrometers of cross sections are set to 2. Moreover, when drawer electrode width of face is as wide as 100 micrometers, rate of electrical installation with a drawer number sufficient [at least one] is obtained.

[0034] In addition, by the manufacture approach mentioned above, the multiple-times laminating of the 2nd magnetic-substance green sheet 15 and 2nd conductor 20 is carried out beforehand, without [an imprint and] forming the middle layered product 21, you may sequential-imprint and the 1st magnetic-substance green sheet 12 which imprinted the 1st conductor 18 further as a middle layered product 21 may be stuck by pressure on the top face of the 1st magnetic-substance green sheet 12, although the laminating was carried out.

[0035]
[Effect of the Invention] This invention can offer the manufacture approach of the laminating chip inductor whose electric connection between an end-face electrode and a conductor is hard to generate a crack in a plane of composition even if it carries out the laminating of a magnetic-substance green sheet and the metaled conductor, and improves as mentioned above.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Process drawing showing the manufacture approach of the laminating chip inductor in the gestalt of 1 operation of this invention
[Drawing 2] Drawing showing the cutting location of the drawer electrode and layered product which are this important section
[Drawing 3] Drawing showing the cutting location of the other drawer electrodes and layered product which are this important section
[Drawing 4] The decomposition perspective view showing the structure of the conventional chip form inductor
[Drawing 5] This perspective view
[Description of Notations]
11 1st Base Material
12 1st Magnetic-Substance Green Sheet
13 Through Tube
14 Electrical Conducting Material
15 2nd Magnetic-Substance Green Sheet
16 2nd Base Material
17 Drawer Electrode
18 1st Conductor

19 3rd Base Material
20 2nd Conductor
21 Middle Layered Product
22 Layered Product
23 Piece of Individual
24 End-Face Electrode

[Translation done.]

* NOTICES *

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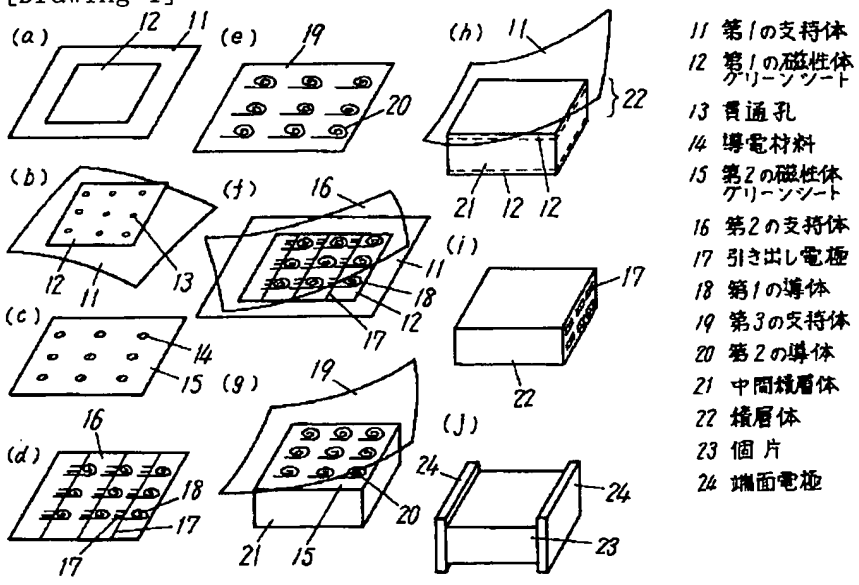
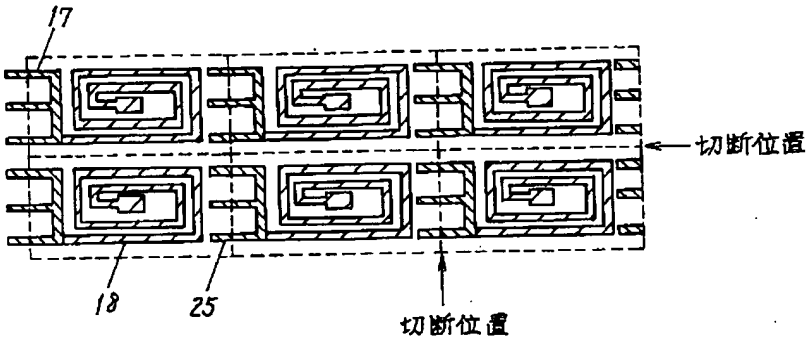
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



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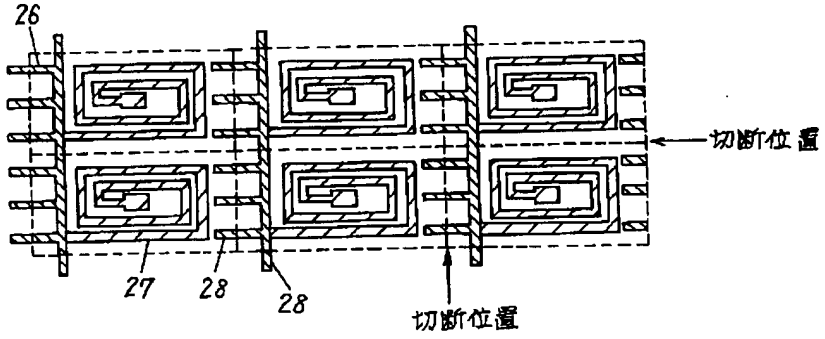
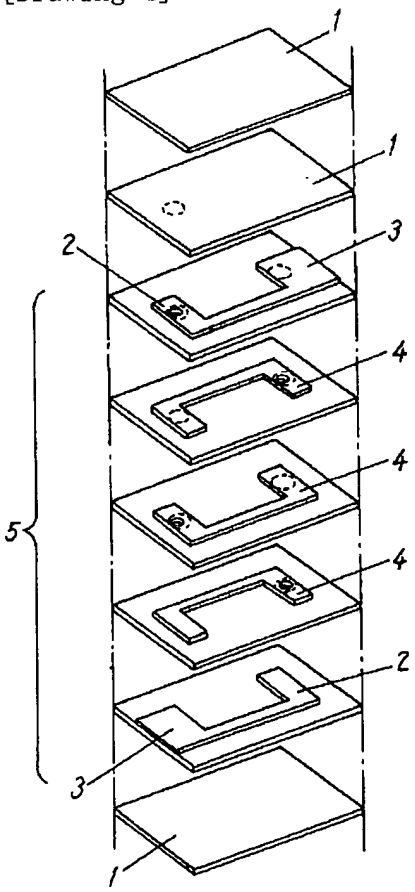
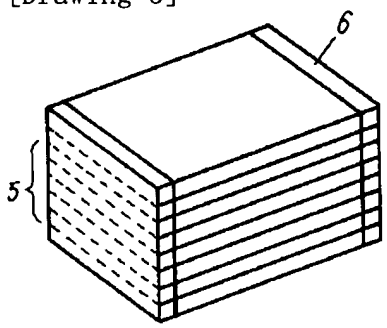


[Drawing 4]



[Drawing 5]



[Translation done.]